

What is claimed is:

1. A corrosion-resistant, threaded connection assembly, comprising:
a first tubular member comprising an outer metal tube of corrosion-prone material and an inner metal tubular lining of corrosion-resistant material, said outer tube having
5 a first end and a second end, said first tubular member comprising a first pin connection on said first end, said first pin connection comprising a first nose portion comprising a first ring of corrosion-resistant material secured to said first end of said tube of corrosion-prone material, a first annular securing locus formed between said first ring and said first
10 end of said tube, said first ring defining an annular, axially facing, first end surface, said first pin connection further including a first radially outwardly facing, annularly extending, thread-free pin shoulder formed on said first ring and a first axially extending, externally threaded portion providing male threads formed at least partially on said tube and extending axially inwardly of said first pin shoulder, said first securing locus being
15 disposed intermediate said first end surface and the end of said first externally threaded portion distal said first end surface;
a second tubular member comprising a metal coupling having a first end and a second end, said coupling having a first box connection formed in said first end and a second box connection formed in said second end, said coupling including an internally disposed, annularly extending section of corrosion-resistant material disposed
20 intermediate said first and second ends of said coupling, each of said box connections comprising a radially inwardly facing, annularly extending box shoulder formed on said section of corrosion-resistant material, each of said box connections further including an axially extending, internally threaded portion providing female threads complementary to said male threads and extending axially outwardly of said thread-free box shoulder;
25 and
said pin and box shoulders being sized and configured such that when respective ones of said first pin connections are threadedly received in said first and second box connections, said pin and box shoulders are in metal-to-metal sealing engagement.
2. The assembly of Claim 1 wherein at least a portion of the first one of said
30 male threads is formed on said first ring of corrosion-resistant material.

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3. The assembly of Claim 1 wherein said first ring of corrosion-resistant material is thread-free.

4. The assembly of Claim 1 wherein said section of corrosion-resistant material defines an annular, radially inwardly extending rib between said first and second box connections.

5. The assembly of Claim 4 wherein said rib assembly forms a first annular, axially facing abutment in said first box connection and a second annular, axially facing abutment in said second box connection.

6. The assembly of Claim 5 wherein when respective ones of said first pin connections are received in said first and second box connections, said first axially facing end surface on one of said first pin connections is in engagement with said first abutment in said first box connection and said first axially facing end surface on the other of said first pin connections is in engagement with said second abutment in said second box connection.

7. The assembly of Claim 6 wherein each of said abutments forms an undercut surface and said first end surface of each of said first pin connections is complementarily shaped.

8. The assembly of Claim 1 wherein said coupling is made entirely of corrosion-resistant material.

9. The assembly of Claim 1 wherein said coupling comprises an outer tubular portion of a corrosion-prone material and an inner, annular insert of corrosion-resistant material, said corrosion-resistant section being formed by said insert.

10. The assembly of Claim 9 wherein said insert is welded to said outer tubular portion of said coupling.

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11. The assembly of Claim 1 wherein said first externally threaded portion on said first pin connection defines a first two-step male thread and each of said internally threaded portions in said second tubular member defines a second two-step female thread, complementary to said first two-step thread.

5 12. The assembly of Claim 11 wherein said first two-step thread defines a first threaded male portion and a second threaded male portion, axially spaced from said first threaded male portion, an annular, axially facing, pin makeup shoulder being formed between said first and second threaded male portions and each of said second two-step threads defines a first threaded female portion and a second threaded female portion,
10 axially spaced from said first threaded female portion, a first annular, axially facing makeup shoulder being formed between said first and second threaded female portions in said first box connection, a second annular, axially facing box makeup shoulder being formed between said first and second threaded female portions in said second box connection, said pin makeup shoulders and said first and second box makeup shoulders
15 being engaged when respective ones of said first pin connections are threadedly received in said first and second box connections.

13. The assembly of Claim 12 wherein said pin makeup shoulder is undercut and said first and second makeup shoulders are complementarily shaped.

14. The assembly of Claim 1 wherein one of said first tubular member or said
20 second tubular member includes an annularly extending receiving formation for a deformable seal ring, and there is a deformable seal ring disposed in said receiving formation, said receiving formation and said seal ring being positioned such that such seal ring effects sealing between the interior of said second tubular member and the exterior of said first tubular member.

25 15. The assembly of Claim 1 wherein said first securing locus is disposed in said first externally threaded portion.

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16. The assembly of Claim 1 wherein said lining of corrosion-resistant material overlies said first annular securing locus and is secured to said first ring.

17. The assembly of Claim 1 wherein said tubular lining of corrosion-resistant material has a first end, said first end terminating short of said first end of said outer tube, said first ring of corrosion-resistant material including a tubular flange portion extending axially of said first ring distal said first end surface, said tubular flange portion having an O.D. substantially the same as the I.D. of said outer metal tube and being received in said first end of said tube, the first end of said tubular flange portion distal said first end surface being secured to said first end of said tubular lining by an annular weld of corrosion-resistant material.

18. The assembly of Claim 17 wherein said first securing locus is disposed between said first end surface and said annular weld of corrosion-resistant material securing said tubular flange and said tubular liner.

19. The assembly of Claim 18 wherein said first securing locus is defined by an annular weld of corrosion-resistant material.

20. The assembly of Claim 16 wherein said tubular lining has a first end extending beyond said first end of said outer metal tube, said first ring including a cylindrical counterbore formed on the end of said first ring distal said first end surface, said counterbore defining an annular abutment surface, the portion of said tubular lining extending beyond said first end of said tube being received in said counterbore, said tubular lining being secured to said first ring by an annular weld of corrosion-resistant material between said first end of said tubular lining and said abutment surface formed in said first counterbore.

21. The assembly of Claim 20 wherein said first securing locus is defined by an annular weld of corrosion-resistant material between said ring and said outer tube.

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22. The assembly of Claim 1 wherein said first tubular member further includes a second pin connection, said second pin connection comprising a second nose portion comprising a second ring of corrosion-resistant material secured to said second end of said tube of corrosion-prone material, a second annular securing locus formed
5 between said second ring and said second end of said tube, said second ring defining an annular, axially facing second end surface, said second pin connection further including a second radially outwardly facing, annularly extending threadfree shoulder formed on said second ring and a second, axially extending, externally threaded portion providing male threads formed at least partially on said tube and extending axially inwardly of said
10 second pin shoulder, said second securing locus being disposed intermediate said second end surface and the end of said second externally threaded portion distal said second end surface.

23. The assembly of Claim 22 wherein said inner metal lining of corrosion-resistant material overlies said first and second annular securing loci and is secured to
15 said first and second rings.

24. A workpiece for use in making a corrosion-resistant, threaded tubular member, comprising:
an outer metal tube of corrosion-prone material having a first end, a second end, and an inner surface, a first ring of corrosion-resistant material secured to said first end
20 of said metal tube, a first annular securing locus formed between said first ring and said first end of said metal tube, an inner metal tubular lining of corrosion-resistant material disposed in said outer tube, said metal lining having a first end, a second end, and an outer surface, said outer surface of said lining overlying said inner surface of said tube and said first annular securing locus, said first end of said lining being secured to said
25 first ring.

25. The workpiece of Claim 24 wherein said first annular securing locus comprises an annular weld.

26. The workpiece of Claim 24 wherein said lining is secured to said tube.

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27. The workpiece of Claim 24 wherein a second ring of corrosion-resistant material is secured to said second end of said metal tube, a second annular securing locus being formed between said second ring and said second end of said metal tube, said outer surface of said lining overlying said second annular securing locus, said second end of
5 said lining being secured to said second ring.

Sub B2 > 28. A method of forming a workpiece for use in making a corrosion-resistant, threaded tubular member, comprising:

providing a metal tube of corrosion-prone material, said metal tube having a first end and a second end;

10 securing said first end of said metal tube to a first ring of corrosion-resistant material by permanently bonding said first ring to said first end of said metal tube to form a first annular securing locus between said first ring and said first end of said tube;

providing a metal tubular liner of corrosion-resistant material, said liner having a first end and a second end;

15 disposing said liner in said tube, said liner overlying said first annular securing locus and being secured to said first ring.

29. The method of Claim 28 wherein said securing of said first ring to said first end of said tube is accomplished by welding.

20 30. The method of Claim 29 wherein said welding is conducted by friction welding.

Sub B3 > 31. The method of Claim 30 wherein said liner is secured to said metal tube.

32. The method of Claim 28 wherein said first ring has a first end surface distal said first annular securing locus and said first end of said liner extends to said first end surface of said first ring, said first end of said liner being welded to said first ring at
25 said first end surface.

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33. The method of Claim 28 wherein said first end of said liner terminates short of said first end surface of said first ring and comprising the further steps of forming an annular weld on said first ring extending from said first end surface of said first ring to said first end of said liner, said annular weld being bonded to said first end
5 of said liner and said first ring.

34. The method of Claim 28, further comprising:
securing to said second end of said metal tube a second ring of corrosion-resistant material by permanently bonding said second ring to said second end of said metal tube to form a second annular securing locus between said second ring and said first end, said
10 liner overlying said second annular securing locus and being secured to said second ring.

35. The method of Claim 34 wherein said securing of said second ring to said second end is accomplished by welding.

36. The method of Claim 35 wherein said welding is conducted by friction welding.

37. The method Claim 34 wherein said second ring has a second end surface distal said second annular securing locus and said second end of said liner extends to said second end surface of said second ring, said second end of said liner being welded to said second ring at said second end surface.
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38. The method of Claim 34 wherein said second end of said liner terminates short of said second end surface of said second ring and comprising the further steps of forming an annular weld on said second ring extending from said second end surface of said second ring to said second end of said liner, said annular weld being bonded to said
20 second end of said liner and said second ring.

39. A corrosion-resistant, externally threaded tubular member, comprising:
25 an outer metal tube of corrosion-prone material having a first end, a second end, and an inner surface, a first ring of corrosion-resistant material secured to said first end

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of said metal tube, a first annular securing locus formed between said first ring and said first end of said metal tube, an inner, metal tubular lining of corrosion-resistant material disposed in said outer tube, said metal lining having a first end, a second end, and an outer surface, said outer surface of said lining overlying said inner surface of said tube and said first annular securing locus, said first end of said lining being secured to said first ring, said first ring defining an annular, axially facing first end surface and a first axially extending, externally threaded portion providing male threads formed at least partially on said tube and extending axially inwardly of said first end surface, said first securing locus being disposed intermediate said first end surface and the end of said first externally threaded portion distal said first end surface.

40. The tubular member of Claim 39 wherein a first radially outwardly facing, annularly extending threadfree pin shoulder is formed on said first ring.

41. The tubular member of Claim 39 wherein said first annular securing locus comprises an annular weld.

42. The tubular member of Claim 39 wherein said lining is secured to said tube.

43. The tubular member of Claim 39 wherein a second ring of corrosion-resistant material is secured to said second end of said metal tube, a second annular securing locus formed between said second ring and said second end of said metal tube, said lining overlying said second annular securing locus, said lining being secured to said second ring, said second ring defining an annular, axially facing second end surface and a second, axially extending, externally threaded portion providing male threads formed at least partially on said tube and extending axially inwardly of said second end surface, said second securing locus being disposed intermediate said second end surface and the end of said second externally threaded portion distal said second end surface.

44. The tubular member of Claim 43 wherein a second, radially outwardly facing, annularly extending, threadfree pin shoulder is formed on said second ring.

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45. The tubular member of Claim 43 wherein said second annular securing locus comprises an annular weld.

46. A method of forming a corrosion-resistant, externally threaded tubular member, comprising:

5 providing a metal tube of corrosion-prone material, said metal tube having a first end and a second end;

securing to said first end of said metal tube a first ring of corrosion-resistant material by permanently bonding said first ring to said first end of said metal tube to form a first annular securing locus between said first ring and said first end of said metal tube, said first ring forming a first end surface;

10 providing a metal tubular liner of corrosion-resistant material, said liner having a first end and a second end;

disposing said liner in said tube, said liner overlying said first annular securing locus and being secured to said first ring; and

15 forming a first axially extending, externally threaded portion providing male threads, said first threaded portion extending axially inwardly of said first pin end surface and being at least partially formed on said tube, said first securing locus being disposed intermediate said first end surface and the end of said first externally threaded portion distal said first end surface.

20 47. The method of Claim 46 including forming a first radially outwardly facing, annularly extending, threadfree pin shoulder on said first ring.

48. The method of Claim 46, comprising forming at least a portion of the first one of said male threads on said first ring of said first threaded portion.

25 49. The method of Claim 46, comprising securing a second ring of corrosion-resistant material to said second end of said tube by permanently bonding said second ring to said second end of said tube to form a second annular securing locus between said second ring and said second end of said metal tube, said second ring forming a second end surface; and

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forming a second, axially extending, externally threaded portion providing male threads, said second threaded portion extending axially inwardly of said second end surface and being at least partially formed on said metal tube, said second securing locus being disposed intermediate said second end surface and the end of said second
5 externally threaded portion distal said second end surface.

50. The method of Claim 49, including forming a first radially outwardly facing, annularly extending, threadfree pin shoulder on said first ring.

51. The method of Claim 49, comprising forming at least a portion of one of said male threads of said second threaded portion on said second ring.

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